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ABSTRACT

The traditional dichotomies of urban and rural may no longer be valid. Investigating whether or not there are socially significant areal units to redefine rural and urban areas, the report described one attempt to delineate such units and to test them for sociological utility. Counties were placed in homogeneous social units based upon the characteristics of the resident population. The methods utilized were termed "factor ecology" and the phenomenon chosen for the test of social utility was selected patterns of migration. The latter choice was arbitrary; the emphasis herein concerned methods and their verification. The areas tested -- 208 counties in Missouri and Nebraska -- were for experimental purposes only, but they did represent a broad range of socioeconomic conditions. The process used 8 steps: (1) determine the relevant variables that describe each county's population; (2) subject these to factor analysis; (3) from step 2 obtain the factors and significant variables for each factor; (4) determine the index score for each factor for each county through the use of factor loadings; (5) standardize the index scores; (6) divide the standardized scores into quartiles; (7) delineate the counties into homogeneous, non-continuous social units based upon the quartiles; and (8) test the resulting areal units by comparing them with areal units formed through analysis of migration patterns. (KM)

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A METHOD OF DELINEATION OF HOMOGENEOUS SOCIAL-ECOLOGICAL AREAS

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INTRODUCTION

The traditional dichotomies of urban and rural may no longer be valid.[1] The rapidly changing and urbanizing social structure of what were once rural areas has created a need for a better understanding of today's social-ecological patterns.[2] The rural-urban dichotomy was developed for a much simpler society in which modes of communication and transportation encouraged separation and concentration of various functions. Today, formerly rural areas are increasingly heterogeneous in character; any ecological categories that lump all these areas together probably obscure more than they reveal. A large metropolitan area today, which usually consists of several counties and numerous subunits, can range from agricultural open country through various strata of suburbs to the central city with its ghettos. The obvious question is if such traditional dichotomies as rural-urban and metropolitan-nonmetropolitan are not very useful, are there other areal units that are more socially significant?[3]

The purpose of this report is to describe one attempt to delineate such units and to test them for sociological utility. Briefly, we have attempted to develop and test a method of placing counties into homogeneous social units[4] based upon the characteristics of the resident population. The methods we utilized are termed "factor ecology," and the phenomenon chosen for the test of social utility was selected patterns of migration. The latter choice is arbitrary; a number of others could have been chosen. The emphasis herein concerns methods and their verification. The areas tested — all counties in Missouri and Nebraska — were for experimental purposes only. However, they do provide a wide range of variation for many characteristics of the population. The method is currently being utilized in other geographical contexts,

and results of this further analysis will be reported at a later date.

The complex process necessary to accomplish the above-stated purpose is outlined below:

Step 1: Determine the relevant variables that describe the population in each county.

Step 2: Subject these to factor analysis.

Step 3: From Step 2 obtain the factors and significant variables for each factor.

Step 4: Determine the index score for each factor for each county county through the use of factor loadings.

Step 5: Standardize the index scores.

Step 6: Divide the standardized scores into quartiles.

Step 7: Delineate the counties into homogeneous, non-contiguous social units based upon the quartiles.

Step 8: Test the resulting areal units by comparing them with areal units formed through analysis of migration patterns

The remainder of this report describes the above process in more detail.

JUSTIFICATION

The early census definitions of "rural and "urban" divided a geographic area and its population into a simple dichotomy, with a limited number of subunits within each category (farm and non-farm).

The human ecology research in sociology was given an early, major impetus from the studies of Chicago by Park and Burgess.[5] In rural areas the works of Lively,[6] Mangus,[7] and Gregory,[8] were among the early pioneering efforts. Bogue's description[9] of state economic areas has stood as a major contribution to the study of georgraphic areas. In more recent years, as sociology drifted away from community and area research toward social-psychological studies, the number of attempts to create homogeneous social areas has been

relatively small. Most of the ecology studies that have been completed have concentrated on the metropolitan areas; rural area delineations have been generally abandoned.

While sociologists were moving away from such studies, the need for new delineations of areas increased dramatically. Industrialization, urbanization through commuting, development of recreational areas, and commercialization of agriculture have had differential effects on formerly relatively homogeneous areas. Rural sociologists today frequently observe differential rates of social and economic change among areas and communities. The rapid rates of change in communities especially since World War II have made obsolete the traditional labels of rural and urban, but sociologists have been very slow in developing alternatives. Beale,[10] Hathaway,[11] Campbell,[12] and others[13] have pointed out the difficulty of attempting to differentiate modern society on the basis of dichotomous categories. One of the problems has been to find an alternative that is as simple and easy to understand as the rural-urban dichotomy. This search is fruitless because of the complexity of today's society. Thus, as a first step, we are abandoning any idea of a dichotomous classification and will be considering the entire subject area and its population.

The few systematic areal analyses made recently have focused upon two formulations: social area analysis and factorial ecology. The homogeneous interpretation of social areas stems more recently from the research conducted by Shevky and Williams,[14] who were mainly interested in describing the organization and differentiation of urban subareas in industrial society. They utilized the constructs of social rank, family status, and ethnic status. Using variables from the census for each of these constructs, they computed indexes for census tracts and were thus able to delineate urban subareas.

The urban subareas thus delineated as social areas were then ranked according to their scores on the three indexes. The social, non-contiguous areas then formed the basis for comparative ecological analysis.

The recent development of social area analysis has expanded to a more generalized selection and indexing of empirical indicators of social differentiation. This generalization has also affected the analysis of areas under study. The methods have been called "factorial ecology" — the application of the statistical procedures of factor analysis to a more elaborate and comprehensive set of variables.[15] A more objective and inductive approach to investigating the extent to which subareas are differentiated socially, factorial ecology, as initially applied, was a procedure for analysis of the relationship among a larger number of socioeconomic and demographic variables.[16]

The formulation of social areas by Shevky and Williams[17] provided a vehicle for a more thorough understanding of a wider system of relationships than had been used in traditional urban ecological research. Jonassen[18] and much later Berry[19] formulated schema for comparative analysis for the broader regional orientation. From this orientation came the work of Groth[20] in his classification of counties of the 48 contiguous states of the United States.

The process leading to a multidimensional perspective of subnational areal differentiation has passed through three stages. These three stages are exemplified in the work conducted by Shevky and Williams,[21] Jonassen,[22] Berry,[23] Groth,[24] and Beale.[25] First, Shevky and Williams were able to conclude that social areas could be delineated on the basis of three specific factors that significantly differentiate modern society — urbanization, social rank, and segregation. Second, Jonassen and Berry extended this

concept of urban social area differentiation to include inter-urban areas as well. The work conducted by Groth solidified this regional orientation, and the subsequent analysis by Beale reaffirmed this regional perspective, namely, that subnational areal differentiation must be based on a multidimensional perspective.

The application of subnational areal differentiation described in this report stems directly from the conceptual development given above. The application of the procedures, to be described, has led to a verification that they apply to the particular migration phenomenon treated in this study.

STUDY AREAS

This study focuses on delineation of social units composed of counties in Missouri and Nebraska and on comparison of gross migration rates and patterns. Missouri consists of 115 counties and Nebraska 93. Taken together, these two states and their 208 counties represent a broad range of socioeconomic conditions. In addition, the number of counties in the area is sufficient to test the method but few enough not be operationally cumbersome. However, the states of Nebraska and Missouri were chosen not because they were generally representative of the entire United States or of the North Central Region, but because these states were felt to be minimally sufficient to provide an adequate test of procedures.

DATA AND UNITS OF ANALYSIS

The county was employed as the basic unit of analysis for several reasons. The works conducted by Munson[26] and Jonassen,[27] from the perspective of analyzing population changes and structure, have set reliable precedents for

this choice. Rogers's work[28] with the mathematical postulates of various units of analysis for studies of this type indicates no procedural reason to preclude analysis based on county units.

These studies suggest that the choice of unit was based more on availability of reliable and valid data than on geographic specificity or any other criterion. The availability of data was one primary reason for the selection of the county as the basic unit in this study also. The data used herein, much of which were sample data from the 1970 Census of Population and Housing, virtually prohibits analysis of areas smaller than the county because of the questionable quality of data for smaller population aggregates. Although migration was not our central concern, most data employed in the calculation of net migration or other social indicators are not available for areas smaller than the county. We do recognize that heterogeneity has increased within many counties, and if reliable data are available for smaller units, they should be used, especially in and around metropolitan and other very heterogeneous areas.

The procedure of subarea delineation designed in this study precludes any consideration of contiguity of counties. Most of the early delineations of homogeneous rural social areas included contiguity as a requirement on the assumption that adjoining areas were more similar than distant units. The assumption may have beer valid for that time, although it generally was not tested; however, heterogeneity in rural areas has been increasing for many decades. For example, the differential effects of the development of recreational-retirement areas, the establishment of military bases, rural industrialization, and the industrialization of agriculture have all contributed to the increase in heterogeneity of previously homogeneous areas. In most states, socioeconomically homogeneous counties are not necessarily

geographically contiguous. To maintain contiguity, units of varying homogeneity would have to be included, thus reducing the extent of the internal homogeneity of the area.

THE FACTOR ANALYTICAL PROCEDURES

Variables Utilized: Examination of the variables used in previous social area analysis[29] indicates that there are factors that significantly differentiate modern society on a geographic basis. These variables can be grouped into the following categories (terms within parentheses are the specific census items used):

(1) Economic activities (industry classification)

(2) Labor force components (women in the labor force and labor force participation range of specific age groups)

(3) Family (family size and fertility rates)

(4) Labor skills (occupation classification)

(5) Minority groups

(6) Age-sex composition and

(7) Socioeconomic status (income, education, housing type, and housing value).

Eighty socioeconomic variables were selected to represent the above categories. Items as similar as possible to those used in past research were included.

The application of factor analytic techniques to the variables was the first phase in the delineation. This procedure reduced the original data matrix to a smaller set of factors that could then be considered as source variables that account for the observed interrelations of data. The source variables serve as indicators of emergent dimensions which are employed as

indexes for social differentiation of territorial subunits of the population.

The analytic techniques utilized in factorial ecology have varied in past studies. The initial factor transformations applied by Jonassen[30] and Munson[31] involved construction of an intercorrelation matrix, through the Pearson product-moment formula. This intercorrelation matrix was then factor analyzed, employing the varimax method of rotation. Terminal factors were extracted in terms of maximum variance explained, employing the criterion of orthogonality. Berry,[32] in his study of Calcutta, applied slightly different techniques. The data matrix consisted of the original variables. Principal-component factor analysis, with varimax rotation of all factors with eigenvalues exceeding 1.0 was used to determine orthonormal factor scores for each ecological unit.

Both above methods of factor analysis use variations of orthogonal rotation. In these, the emergent factors have been forced into mathematical independence of one another. Authorities have argued that the constraint of orthogonality is not warranted in analysis of social phenomena and that oblique rotation (where statistical independence is not forced) should be employed. In the oblique rotation, if the emergent factors are in fact independent, the independence will be a function of the variables that comprise the factors and not of the statistical techniques employed to isolate them.

On this point there seems to be no resolution. On one hand, Rummel[33] states that "the oblique rotation has greater flexibility (than the orthogonal rotation) in searching out patterns regardless of their correlation." On the other hand, Nie and Hull[34] state that "there is no compelling reason to favor one method over another, and the choice should be on the basis of

the particular needs of a given research problem." Hunter,[35] while suggesting that various techniques be simultaneously employed, states that because factorial ecologists are often interested in computing factor scores, the issue focuses upon computing unique indexes of variables isolated within each terminal factor. In summary, the relevant conclusion drawn by Hunter is that unique scores with regard to social phenomena can be computed which are method independent for analysis. From a purely statistical perspective, then, the specific initial factor and terminal rotation techniques to be applied should be an empirical question determined through evaluation of the data matrix, the research problem, and, to some extent, the data processing services available.

Because of precedents set by previous researchers and because index scores were employed in the manner discussed by Hunter, the factor analysis used in this study was based on an R-type matrix whose initial factors were extracted employing a principal component solution with iteration. The terminal factors were rotated orthogonally according to the varimax technique.

Selection of the specific variables used in the computation of the index scores for each factor was based on the matrix of factors and factor loadings of each of the input variables in the terminal solution. However, the interpretation of the composition of the isolated factors was based on the fact that the factor loading of a variable with reference to any particular factor could be interpreted as its correlation with that factor. Thus, for each of the factors, the respective variables were isolated for use in standardization procedures for computing index scores to delineate the homogeneous areas for each county in each dimension.

ISOLATION OF FACTORS AND SIGNIFICANT VARIABLES

Isolation of the factors is predicated on accepted, although somewhat arbitrary, statistical procedures. With orthogonal rotation to a terminal solution of the initial factor matrix in the factor analysis procedure, values are prepared presenting the percentage of common variance and total variance explained by each of the orthogonal factors. The accepted statistical procedure is to include all factors that account for at least 1% of the common variance. Further, criteria for significance with respect to factor loadings for each variable subjected to analysis are not established. Isolation of "significantly loaded" variables focuses on selecting a maximum number of variables based on the rank order of their factor loadings or designating a minimum value or threshold for factor loading for inclusion of variables in final indexing procedures.

Three factors that accounted for 83.6% of the common variation resulted from the factorial analysis procedures described above (see Table 1). A minimum factor loading of 0.7 was designated for inclusion of the 25 variables in the indexing procedure. The factors were limited to three, because previous research employing factor analysis, either from a social area or factorial ecology perspective, has found that isolation of three or fewer factors was optimum. Further, the central purpose of these procedures in this study is to reduce the complexity of the multidimensional macro-regional analysis that includes a large number of units of analysis. The selection of fewer factors and variables with high loadings, accordingly, lends more stability to subsequent analysis than does selection of factors composed of a larger number of variables with lower, weaker factor loadings. Two

TABLE 1

COMMON VARIATION ACCOUNTED FOR BY EACH FACTOR

Factor	Percentage of variation	Cumulative percentage variation
Social rank-urbanization	41.5	41.5
Family-dependency status	24.3	65.8
Employment-education	17.8	83.6

additional factors were derived which accounted for another 9% of the common variance. If these had been utilized, they would have raised the potential number of areas by a multiple greater than 10.

FACTOR LABELING

Factor labeling in this analysis has been purely descriptive, and an attempt was made to represent the attributes that clustered together. Previously established labeling patterns such as those employed by Shevky and Bell,[37] Berry,[38] and Gregory,[39] have been used to avoid a proliferation of labels. However, this practice was only possible where identified dimensions were similar to previous delineations. Once labeled, each factor then represents that dimension in the differentiation of the study region.

The first factor, social rank-urbanization, clearly represents linkages among variables characteristic of the changing structure of the population, as well as their distribution of occupation skills (see Tables 2 and 3). Construction of the index of social rank-urbanization utilized the positive relationship indicated among the variables of female labor force participation, urban classification of population, housing type, and income level and the negatively associated variables of rural classification of population and lower level occupational groups. An index of this dimension is a composite of variable indicators that include measures of economic, occupational, and residence-type statuses. While references to individuals are unwarranted with regard to the nature of the summary data employed in this analysis,[40] components of the popualtion have been selected which reflect, at one point in time, the differentiating elements of occupational skills, the structure of productive activity, and residence status.

TABLE 2

FACTORS AND RESPECTIVE FACTOR LABELS

		FACTOR ONE: SOCIAL RANK-URBANIZATION
CRFS&LAB	=	Total number of craftsmen, operatives and laborers per 1000 employed persons
FELFPA	=	Percentage of females aged 16 and over in the labor force
FELF14	=	Number of females in the labor force per 1000 females 14 years old and over
HIINC	=	Percentage of families with income of $7,000 or more
HOUSRUR	=	Percentage of total housing classified as rural
LABORERS	=	Percentage of workers classified as laborers in the labor force
MULTIHOUS	=	Percentage of housing structures with 2 or more dwelling units plus mobile homes
POPURB	=	Percentage of total population classified as urban
POPRUR	=	Percentage of total population classified as rural
		FACTOR TWO: FAMILY-DEPENDENCY STATUS
AGED-CHILD	=	Ratio of aged persons to children
BELOW 19	=	Percentage of population below 19 years of age
MCWUND18	=	Percentage of married couples with children under 18 years of age
MCWUND6	=	Percentage of married couples with children under 6 years of age
MCWH45	=	Percentage of married couples with husband under 45 years of age
MEDIAN AGE	=	Median age
NATINC	=	Percentage of population growth due to natural increase
PPEROH	=	Population per occupied housing unit
		FACTOR THREE: EMPLOYMENT-EDUCATION
CRAFTSMEN	=	Percentage of workers classified as craftsmen and operatives in the labor force
DWREDUC	=	Number of persons who have completed no more than 8 years of school per 1000 persons 25 years or older
MA65PA	=	Percentage of males aged 65 years old and over in the labor force
MAEMP	=	Percentage of males employed full time
MALFPA	=	Percentage of males 16 years of age and over in the labor force
MAUNEMP	=	Percentage of males 14 years of age or over unemployed
MSDSCHLYRS	=	Median school years completed for persons 25 years or older
POPMANUF	=	Percentage of total population 16 years of age and older in manufacturing

TABLE 3

ECOLOGICAL FACTORS IN
THE MISSOURI--NEBRASKA STUDY AREA, 1970.
VARIABLE LOADINGS ON THREE FACTORS

Variable	Factor 1	Factor 2	Factor 3
MEDIAN AGE	-0.29369	-0.85788	0.00566
MEDSCHLYRS	0.27218	0.08924	0.85211
MCWUND 6	0.26460	0.78744	0.01492
MCWUND18	0.15444	0.88518	0.20175
MCWF45	0.46803	0.74798	0.05023
MALFPA	0.15284	0.44342	0.72518
MA65PA	0.10199	0.03106	0.75954
FELFPA	0.91547	0.01359	0.11511
MAEMP	-0.06906	0.10449	0.89631
MULTIHOUS	0.70790	0.27233	0.03103
HIINC	0.70538	0.39154	0.30590
MAUNEMP	0.06484	-0.00630	-0.74900
BELOW19	-0.07872	0.90655	0.04443
PPEROH	-0.06300	0.94789	-0.01109
LABORERS	-0.73635	-0.12415	0.57496
CRAFTSMEN	0.27256	0.00260	-0.77875
NATINC	0.32793	0.83012	0.08793
POPURB	0.72568	0.23791	-0.00868
CRFS&LAB	-0.80805	-0.15992	0.18992
DWREDUC	-0.36816	-0.17188	0.78464
FELF14	0.90513	0.16979	0.14006
POPRUR	-0.72696	-0.24835	0.00845
HOUSRUR	-0.73332	-0.23733	0.01203
POPMANUF	0.28171	0.11342	0.70874
AGED-CHILD	-0.14771	-0.86750	-0.06400

Similarly, the second factor, defined as family-dependency status, was constructed from the positive relationships indicated between married couples with dependents and population per occupied housing unit and the negative relationships shared by the variables median age and aged-child ratio. Components of this dimension reflect the differentiating aspects of family size and the nature of the dependent population.

The third factor reflects a selection of variables labeled employment-education status. The cluster of variables which represents this dimension includes indicators of levels of education attained, employment, and occupational characteristics. The positive relationship among these variables indicates a further emphasis upon selected measures of employment and education as a significant index of differentiation. The variables with positive loading are school years completed by those 25 years of age and over, percentage of males 16 years of age and over in the labor force, percentage of males 65 years of age and over in the labor force, and the percentage of males employed full time. The negatively loaded variables were the percentage of males 14 years of age and over unemployed, the percentage of workers classified as craftsmen and operatives in the labor force, the number of persons who have completed no more than eight years of school per 1000 persons 25 years of age and over, and the percentage of the total population 16 years of age and over engaged in manufacturing.

The variables found to be significant in previous research, which focused only on cities, have been those reflecting social rank, urbanization, and segregation. With the exception of the index of segregation and the inclusion of fertility measures in the urbanization index, these dimensions

were also found to be valid in this application For whatever reason, indicators relative to the concentration of either racial or ethnic subpopulations were found to be non-contributory to the task at hand.

THE PROCEDURES OF SOCIAL UNIT ANALYSIS

The construction of index scores and the classification of county units used in this study are replications of the generalized computational techniques employed in the original analysis of the social areas of San Francisco as outlined by Shevky and Bell.[41] All of the index scores were standardized to their respective ranges for the total of Missouri and Nebraska counties. The standardization technique limits the range of scores for each factor to between 0 and 100.[42] For factors with more than one differentiating variable, an average of the standardized scores of the variable, for each dimension was employed. Thus, for each factor one index score was computed.

The delineation of social units followed directly. The index score of each factor for each county fell into one of the quartiles 0-24.99, 25-49.99, 50-74.99, and 75-100. The use of the quartiles is arbitrary, and categories could have been larger or smaller. The number of social units delineated was then a function of the classification of standardized scores into quartiles and the number of factors isolated in the factor analysis.[43] Three-digit numbers represented the quartile rank of each index; for example, an area designated "111" would have scores in the first quartile for all three factors.

By these methods 30 social areas or units were delineated. This number is less than half the potential number of units and thus shows

that there is a distinct tendency for county variables to cluster. The units ranged in size from 1 to 26 counties (see Table 4). Although absolute extremes of the indexes were never reached simultaneously, county groups representing extremely high and low levels of both the social rank-urbanization index and family-dependency status index are evident in this differentiation. Extremes of the index of employment-education seem to occur more frequently than extremes of either of the other two indexes. The mixing of counties from both states into homogeneous groups, as expected, was frequent but not always evident. There are many areas that include counties from both states, and, contrary to what might be expected, this combination occurs both in areas with moderate index scores and in areas that with index scores may be classified as extreme. Because of a combination of unique socioeconomic characteristics of some counties, there were frequent instances of social areas composed of single counties. These areas occurred at all levels and included 7 of the 208 counties. Some of these were central cities or had other relatively rare characteristics.

The units were subjected to examination by sociologists who were knowledgeable of both states. In their judgment, the units had at least "face validity;" that is, the results appeared logical. For example, rapidly urbanizing middle-class suburban counties such as Sarpy County, Nebraska, and St. Charles County, Missouri, were in one group. The units including Missouri Ozarks counties did not include any Nebraska counties, and, conversely, the western Nebraska plains units did not include any Missouri counties.

TABLE 4

NUMBER OF SOCIAL AREAS

Number of counties in area	Total Number of areas	Number of areas in —		
		Missouri[a]	Nebraska[a]	Missouri and Nebraska
1	7	5	2	0
2	6	5	2	1
3	3	3	1	1
4	1	1	0	0
5-9	6	3	4	1
10-14	3	2	2	1
15-19	1	1	1	1
≥20	3	3	2	2
Total	30	23	14	7

[a] Includes areas with counties in both states.

ANALYSIS OF MIGRATION WITH RESPECT TO THE SOCIAL AREAS

Verification of the procedures for patterned factorial design has been restricted so far to ascertaining the composition of factors and the construction of social-ecological units. The final focus of this report is application of this analysis to migration patterns. The problem was to ascertain how much of the variation in migration pattern among counties was accounted for by the social units delineated. Migration was selected because it was not one of the original variables and because it is an important social factor that has ecological patterns of variation. The migration patterns for purposes of this analysis were defined as either in- or out-migration by county during two decades (1950 and 1960). These residually measured migration patterns were compared with the ecological units.

Migration was analyzed using three different typologies. These typologies, which are being used currently for migration analysis in other studies, are discussed below as migration pattern types I, II, and III.[44] Migration-pattern type I included four categories that were the patterns of two decades of net migration. Each county had either an "in" or an "out" for the 1950 and 1960 decades (see Table 5). Such a categorization provides very broad trends in migration patterns.

Migration-pattern type II is composed of three categories of net migration for the 1960 decade only (see Table 5). Six categories of migration are in type III by allowing for magnitude and direction of migration.

The variation in migration patterns accounted for by delineation of the units was measured through an analysis-of-variance technique, which

TABLE 5

TYPOLOGIES OF MIGRATION

Migration Pattern Type I	
Group A:	Those counties showing in migration in the 1950 decade and in migration in the 1960 decade.
Group B:	Those counties showing in migration in the 1950 decade and out migration in the 1960 decade.
Group C:	Those counties showing out migration in the 1950 decade and in migration in the 1960 decade.
Group D:	Those counties showing out migration in the 1950 decade and out migration in the 1960 decade.

Migration Pattern Type II	
Group 1:	Those counties showing an in or out migration of 0 to 4.9% in the 1960 decade.
Group 2:	Those counties showing an in or out migration of 5 to 14.9% in the 1960 decade.
Group 3:	Those counties showing an in or out migration of 15% or more in the 1960 decade.

Migration Pattern Type III	
Group I:	Those counties showing an in migration of 15% or more in the 1960 decade.
Group II:	Those counties showing an in migration of 5 to 14.9% in the 1960 decade.
Group III:	Those counties showing an in migration of 0 to 4.9% in the 1960 decade.
Group IV:	Those counties showing an out migration of 0 to 4.9% in the 1960 decade.
Group V:	Those counties showing an out migration of 5 to 14.9% in the 1960 decade.
Group VI:	Those counties showing an out migration of 15% or more in the 1960 decade.

determined levels of variation between and among counties in the social units. The amount of variation accounted for by the ecological units may be termed the intra-class correlation. In this application, the intra-class correlation coefficient may range in value between 0 and 1.0. F ratios were used to measure the statistical significance.[45] However, because distribution of the ordinal classifications of migration pattern types is probably not normal, the results of the F test were employed as approximations of the statistical significance of grouping counties into social areas and the accountabilities of these groupings for the variation in migration-pattern types.

Table 6 presents the results of the computation of the ratio of variation accounted for by social units within migration-pattern types. Presented also are the F ratios and their associated levels of significance. The percentages of variation in migration-pattern type accounted for by the delineated social areas are overwhelming evidence that, at the 0.01 level of significance, a significant amount of variation in migration is accounted for in the patterned factorial design. The largest amount of variance was explained in type I, which was a gross measure of "in" or "out" migration over two decades. These results suggest that the ecological units do have empirical utility in accounting for some of the variation in social phenomena beyond their own dimensions.

The next step is to apply this procedure to larger areas than the two states included in this report and to internally describe and analyze the resulting units. These efforts are currently under way.

TABLE 6

RATIO OF VARIATION ACCOUNTED FOR BY
ECOLOGICAL UNITS WITHIN MIGRATION PATTERN TYPES
AND THE ASSOCIATED F RATIOS AND P VALUES

Migration-pattern type	Ratio of variation accounted for (r_i)	F ratio	P_r (larger F)
I	0.4399465	6.19	Less than 0.005
II	0.1931613	2.58	Less than 0.005
III	0.3507964	4.57	Less than 0.005

FOOTNOTES

1. R. R. Campbell "Beyond the Suburbs: The Changing Rural Scene," chapter prepared for a forthcoming book to be published by the Social Science Panel on the Significance of Community in the Metropolitan Environment, National Academy of Sciences.

2. D. E. Hathaway, J. A. Beagle, and W. K. Bryant, People of Rural America (Washington, D.C.: Government Printing Office), 1960 Census Monograph, 1968.

3. We are not suggesting that density of population, which is the principal criterion for determining rural and urban, does not have some validity. Our results show that it does. Rather, we are suggesting that it alone is too simple.

4. The term "social unit" is used herein to designate groups of relatively homogeneous counties. They are not necessarily contiguous groupings. (This will be discussed in more detail in a later section.) The traditional term, "social areas," was avoided because to many people this suggests contiguousness.

5. Human ecology as a concept was initially referred to by R. E. Park and F. W. Burgess, An Introduction to the Science of Sociology (Chicago: University of Chicago Press), 1921, pp. 161-216. Descriptive analysis first appeared in R. E. Park, F. Burgess, and R. P. McKenzie, The City. (Chicago: University of Chicago Press), 1925.

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7. A. R. Mangus, The Rural Regions of the U.S. (Washington, D.C.: U.S. Government Printing Office), 1940.

8. C. L. Gregory, Rural Social Areas in Missouri, (Columbia: University of Missouri), Research Bulletin 665, College of Agriculture, Agricultural Experiment Station, April, 1958.

9. D. J. Bogue, The Strucutre of the Metropolitan Community: A Study of Dominance and Subdominance, Ph.D. dissertation, University of Michigan, 1949.

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11. D. E. Hathaway, J. Allan, and W. K. Bryant, People of Rural America (Washington, D.C.: Government Printing Office), 1960 Census Monograph, 1968.

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14. E. Shevky and M. Williams, The Social Areas of Los Angeles: Analysis and Typology (Berkeley and Los Angeles: University of California Press), 1949.

15. C. T. Jonassen, The Measurement of Community Dimensions and Elements (Columbus, Ohio: Center for Educational Administration, Ohio State University), 1959; B. J. L. Berry, "The Factorial Ecology of Calcutta," American Journal of Sociology, 74: 445-491 (March 1969).

16. M. J. Hagood, N. Danilevsky and C. O. Beam, "An Examination of the Use of Factor Analysis in the Problem of Subregional Delineation," Rural Sociology, 6: 449-552 (May 1942).

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20. P. G. Groth, "Functional Classification of Counties: Some Applications," paper presented at the Annual Rural Sociology Meeting, Baton Rouge, Louisiana, 1972.

21. Shevky and Williams, The Social Areas of Los Angeles.

22. Jonassen, The Measurement of Community Dimensions and Elements.

23. Berry, "The Factorial Ecology of Calcutta."

24. Groth, "Functional Classification of Counties."

25. Beale, "Needed Rural Population Research."

26. B. E. Munson, Changing Community Dimensions (Columbus: Ohio State University Press), 1968.

27. Jonassen, The Measurement of Community Dimensions and Elements.

28. A. Rogers, Matrix Methods in Urban and Regional Analysis (San Francisco: Holden Day, Inc.), 1971.

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31. Munson, Changing Community Dimensions.

32. Berry, "The Factorial Ecology of Calcutta."

33. R. J. Rummel, "Understanding Factor Analysis," Journal of Conflict Resolution, 1: 444-467 (December 1967).

34. N. H. Nie and C. H. Hull, Statistical Package for the Social Sciences (New York: McGraw-Hill), 1970, p. 212.

35. A. A. Hunter, "Factorial Ecology: A Critique and Some Suggestions," Demography, 9: 107-117 (February 1972).

36. The iteration procedure for improving the estimates of communality is a two-stage process recommended and discussed by Nie and Hull, Statistical Package, 220.

37. E. Shevky and W. Bell, Social Area Analysis (Stanford, California: Stanford University Press), 1955.

38. Berry, "The Factorial Ecology of Calcutta."

39. Gregory, Rural Social Areas in Missouri.

40. W. S. Robinson, "Ecological Correlations and the Behavior of Individuals," American Sociological Review, 15: 351-357 (June 1950).

41. Shevky and Bell, Social Area Analysis.

42. The standardization formula is:

$s = x(r-1)$ where s = standardized score,
r = the value of the variable for a particular county,
1 = lower limit of county variable selected for analysis, and
$x = 100/$ (range of the county variable selected for analysis)

For those variables having an inverse relationship to the terminal factor, the standardization formula required shall be expressed as:

$s = 100 - [x(r-1)]$

43. The potential number of units for this combination was 64. The division of the index scores into quintiles would have resulted in a potential of 125 units. The internal homogeneity of the units with a larger number would have been greater. Because the total number of counties in the two-state areas was only 208, the quintile division would have resulted in a large number of single county units.

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44. The three migration-pattern types and their specific thresholds are those that have been and are being employed by the North Central Region, of which the states of Missouri and Nebraska are a part. The analysis of migration as one of two major components of this study stems from much of the pertinent research and analysis of the North Central Region of the United States conducted by the North Central Regional Technical Committee on Population Dynamics NC-18 and NC-97.

45. H. Scheffe, Analysis of Variance (New York: Wiley and Sons), 1954.